ADITYA ENGINEERING COLLEGE

TEAM ID : 24002

TEAM TACHYON

RACE . WRENCH . REPEAT

Excellence through passion.

BAJA 2020

TEAM ID	CAR NO	ENDURANCE SCORE	TOTAL SCORE	POSITION
20014	2	248.5	596.9	8

BAJA 2023

TEAM ID	CAR NO	ENDURANCE SCORE	TOTAL SCORE	POSITION
23004	87	-	163.24	-

LESSONS LEARNT FROM 2023 VEHICLE

SUBSYSTEMS	FLAWS OF PREVIOUS VEHICLE	LESSONS LEARNT	IMPROVEMENT
ROLL CAGE	- The front bracing member should have been the primary member but became secondary member - No gusset between RHO & RRH	- Fbm should become primary and continuous - Should be available gusset secondary according to rule book	FBM completely replaced with primary
SUSPENSION	- Less camber control because of u arms	A-arms tend to offer more adjustability, To fine-tune the suspension settings for specific driving conditions.	- Damper position changed to upper arm - U- arms are replaced with A-arms
BRAKING	- Less brake performance at rear wheels - Occurance of brakages in hoses.	- Due to Y – split - Because of non-metallic liners.	- Installing X- split braking circuit - Using metallic brake liners
STREERING	- The ability to align the wheels not accurtely	- No precise alignment	- Using sliding pair
TRANSMISSION	Less traction & limited torque distribution .	To required power to all 4 wheels	- 4WD

BREAKDOWN AND FAILURES

- No proper design for splash shield arrangement
- Issue in fixing the CVT and disk wheel casing

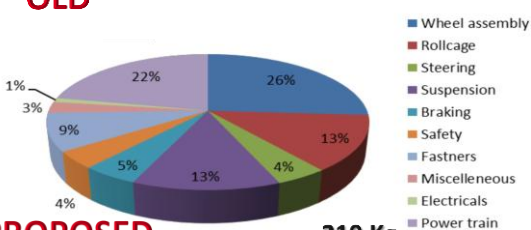
MODIFICATIONS DONE

- Decrease the height of engine bed
- Upgraded the braking system to handle the increased power

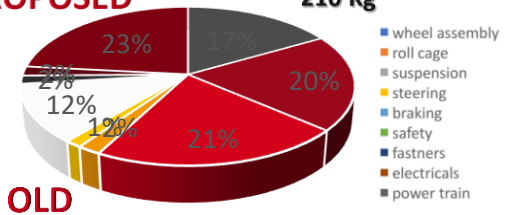
COMPARISION OF OLD AND PROPOSED VEHICLE

PARAMETER	RULEBOOK	OLD	PROPOSED
Maximum Length	108 inch	72 inch	79.26 inch
Maximum Width	64 inch	50 inch	51 inch
Track width (front & rear)	-	45 & 44 inch	51 & 52 inch
Wheel Base	-	50 inch	54 inch
Ground Clearance	-	12 inch	12 inch
Maximum Speed	60 Kmph	53.01 kmph	53 Kmph
Maximum Acceleration	-	5.09 m/s^2	6.7 m/s^2
Gradability	-	63.89 %	70%
Gear box reduction	-	11.1:1	10: 1
Stopping distance	8m@ 45-60 Kmph	4m@ 45 Kmph	4.5 m@ 60 Kmph
Gross weight	-	240 kg	280 kg
Sprung & unsprung mass	-	175 & 65 kg	230 & 50 kg
CG height	-	15.82 inch	15.5 inch
Kerb weight	-	170 Kg	210 kg
Braking circuit	-	Y – split F/R	X – split F/R

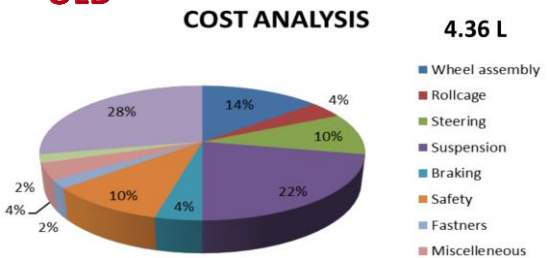
OLD



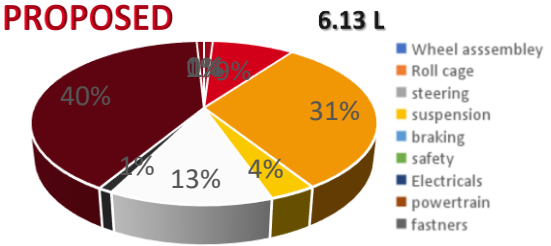
PROPOSED



OLD



PROPOSED



ROLLCAGE DESIGN PROCESS- ERGONOMICS

ROLL CAGE FEATURES

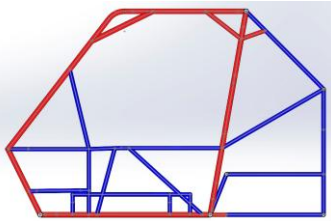
PARAMETER	VALUE
Total no.of joints	94
Total weld length	5.9 m
Total tubing length	50 m
Roll cage weight	41.3 kg

PARAMETER	OUTER DIA	THICKNESS
Primary pipes	31.75 mm	1.6 mm
Secondary pipes	25.4 mm	1.6 mm

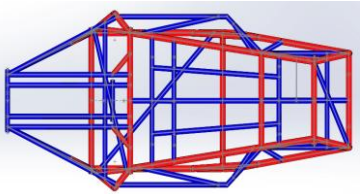
PARAMETER	ALLOWABLE VALUE	DESIGN VALUE
Maximum vehicle width	64”	50”
Maximum vehicle length	108”	72”
Minimum firewall width of the RRH 27” above seat	> 29”	30”
Material used	Steel alloy with properties > 365 Mpa	AISI 4130
Vertical distance of SIM from seat (inches)	8”- 14”	12”
Fire wall angle	Max 20^0	10^0
Front bracing member angle	< 45 “	33.46”

PARAMETER	STD.VALUE	DESIGN VALUE
Elbows angle	125^0 - 140^0	135^0
Knee angle	120^0 - 150^0	132^0
Back angle	8^0 - 15^0	10^0
Steering angle	90^0 - 65^0	70^0

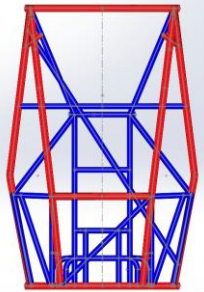
SIDE VIEW



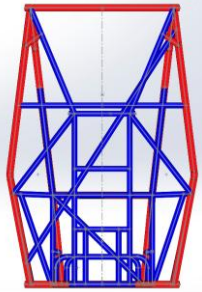
TOP VIEW



FRONT VIEW



REAR VIEW



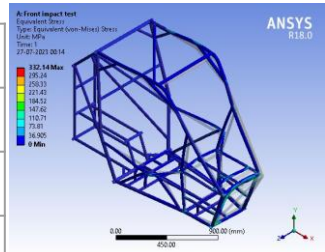
CAE PROCESS

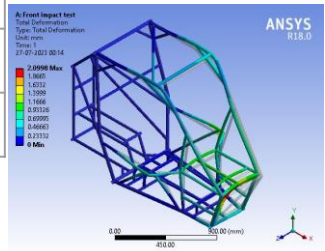
PROPERTY	FRONT IMPACT	REAR IMPACT	SIDE IMPACT	ROLLOVER IMPACT
Weight of the vehicle	280 kg	280 kg	280 kg	280 kg
Load	7780.889 N	7780.889 N	5833.33 N	3580.299 N
Maximun Equivalent stress	332.14 N/mm^2	258.58 N/mm^2	308.97 N/mm^2	141.67 N/mm^2
Maximum Deformation	2.098 mm	1.756 mm	2.588 mm	2.937 mm
Factor of Safety	1.3	1.7	1.4	3.11

Material	YS(Mpa)	US (Mpa)	Elongation	Weldability	C (%)	S(%)	P(%)	Mn
AISI 4130	460	560	21.5%	Very good	0.28	0.04	0.03	0.40
AISI 1144	620	745	10%	Good	0.48	0.33	0.04	1.65
AISI 1018	370	440	15%	Good	0.20	0.05	0.04	0.90
ASTM A106	330	205	18%	Good	0.25	0.03	0.03	0.93

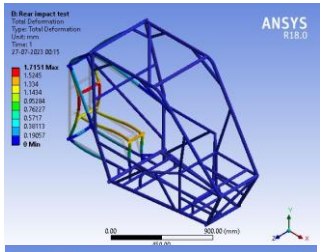
Design software : solid works 2016
Analysis software : Ansys work bench 18.0
Type of analysis : Static structural analysis
Type of solver : Beam method
Mesh type (3D) : Tetra hedral mesh
Element size : 8 mm
No.of nodes : 702235
No.of elements : 347762

FRONT

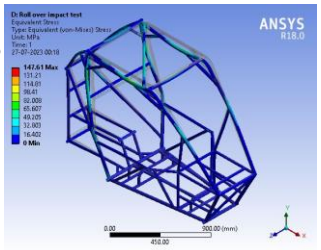


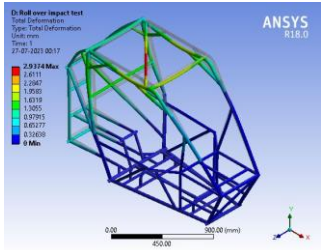


REAR

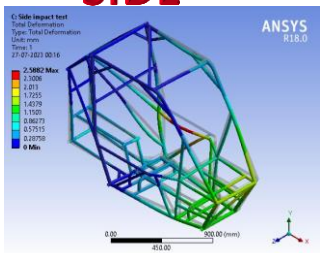


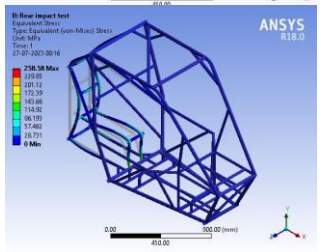
ROLL OVER





SIDE



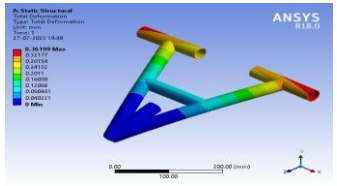


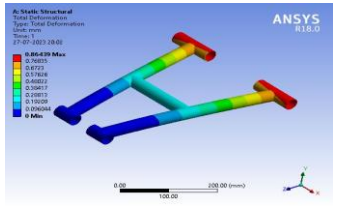
SUSPENSION

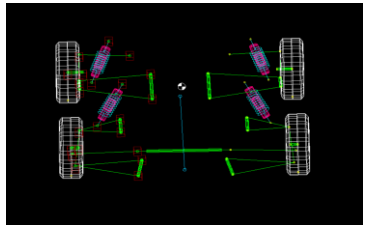
PARAMETER	FRONT	REAR
Suspension system	Double wish bone	H - arm
Natural frequency	2.3 Hz	2.5 Hz
Spring stifness	6.942 N/mm	16.147 N/mm
Roll rate	19.315 Nm/deg	22.28 Nm/deg
Suspension travel	Bump - 6” Droop - 4”	Bump – 4” Droop – 2”
Damper stroke	5.8”	6.2”
Damping force	956.456 N	1103.52 N
Damping coefficient	2940.53 N.s/m	3410.77 N.s/m
Damping ratio	1.08	10.7
Wheel rate	10”-6”bump,4”droop	6” (4” bump,2” droop)
Shock absorber	FOX FLOAT – 3EVOL	Helical suspension

SPRING DESIGN

MATERIAL	Chromium vanadium steel
Modulus of rigidity	8000 mpa
Wire diameter	9 mm
Eye to eye distance	480 mm
No.of active coils	15
Nominal diameter	81 mm







LINKAGE DESIGN

PARAMETER`	VALUE
CG height	15.5’’
Ground clearance	12”
Roll center height	FAW 12.52” RAW 12.49”
Motion ratios	FRONT - 0.53 REAR - 1.33

STEERING GEOMETRY

PARAMETER	FRONT	REAR
Camber	2”	2”
Caster	2”	0”
KPI	8”	0”
Scrub radius	22 mm	0 mm
TOE	2 deg	0 deg

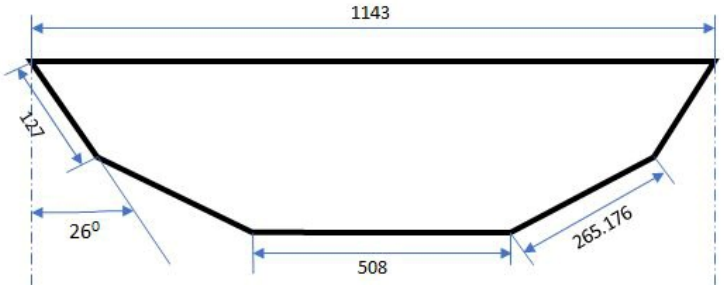
STEERING

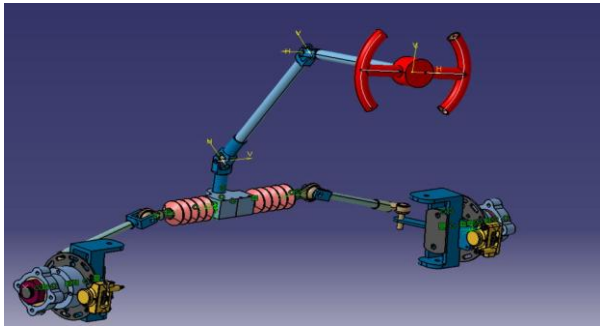
STEERING SYSTEM

PARAMETER	VALUE
Steering condition	Over steer
Ackerman percentage	106 %
Outer angle	24.049
Inner angle	38.09
Turning circle radius	2.5 m

STEERING GEAR- RACK & PINION

PARAMETER	VALUE
LHD OR RHD	Central drive
Rack travel	20.165 mm
Lock to lock turns	1.5 rev
Streering ratio	9:1
OBJ center distance	18.68 “
IBJ center distance	10 “
Length of the rod	10.44”



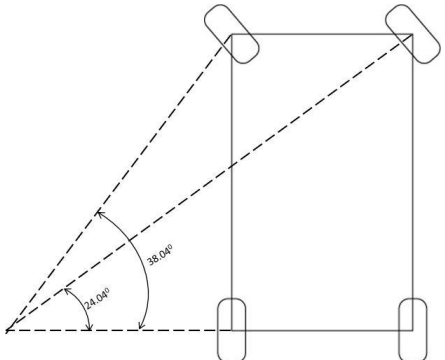


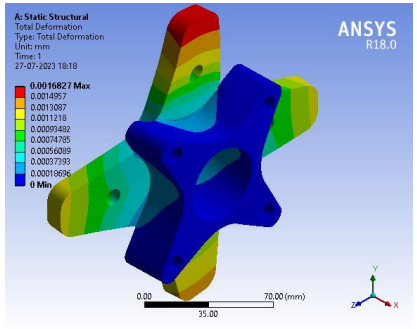
STEERING WHEEL

PARAMETER	VALUE
Wheel diameter	304 mm
Wheel torque	6.6 N-m

STEERING COLUMN

PARAMETER	VALUE
Column type	collapsible
Without power assist	





BRAKING

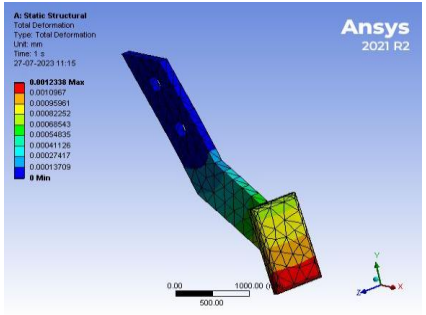
COMPONENT	SPECIFICATION
Circuit type	F/R
Master cylinder	BOSCH TMC Bore- 19.05 mm
Brake disk	F&R – 170 mm
Brake caliper (double piston)	F&R- 25.4 mm
Brake caliper pad – mean breaking radius; area and friction coefficient	150mm, 351 mm^2, 0.4
Brake fluid	DOT -3

BRAKE CACULATIONS

PARAMETER	VALUE
Weight transfer at 40 kmph to 0 kmph	123.8 kg
Static rolling radius for tire	11.21”
Coefficient of friction for road	0.7
Braking torque required per wheel	F-168 N-m R- 64 N-m
Expected brake performance	F- 427.7N-m R- 162 N-m

PERFORMANCE

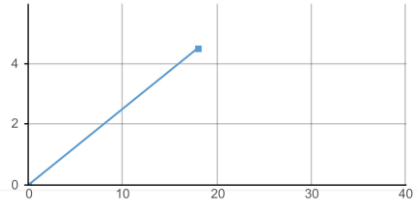
PARAMETER	VALUE
Stopping distance	4.5 m
Pedal force	300 N
Pedal travel	5.2 cm



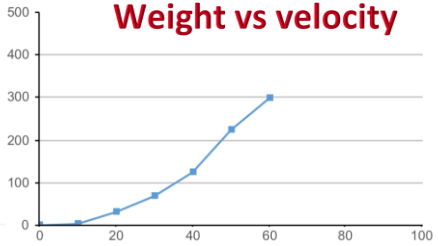
BRAKE INSTALLATION PROBLEMS

PROBLEM	ACTION
Bleeding	Remove air bubbles, renewing brake fluid.
Unbalance circuit	Proportionating valves using flexible hoses.

Velocity vs distance



Weight vs velocity



POWER TRAIN

ENGINE SPECIFICATION

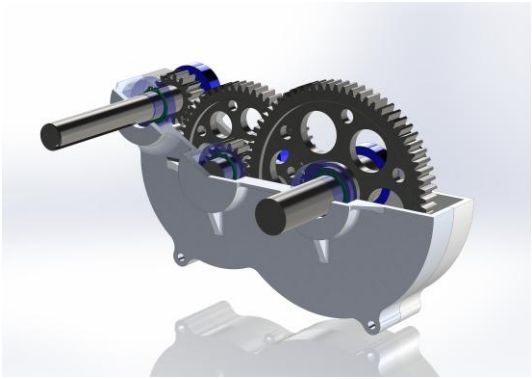
BRIGGS & STRATTON 10 HP OHV – VANGUARD MODEL 20	
PARAMETER	**VALUE**
Max. diameter	189.36 mm
Min. diameter	180.03 mm
Pulley center distance	257 mm
Length of the belt	927 mm
Pulley groove angle	32 deg
Max. power	7.457 KW
Max . torque	18.75 N-m

TYRE SIZE

Diameter	23 inch
Width	7 inch
Height	10 inch

GEAR BOX SPECIFICATION

PARAMETER`	VALUE
Gear train	Double compound Gear train
Gear Reduction ratios	10: 1
Casing material	Aluminium alloy 6065
Gear material	EN 19
Engine : CVT : Gearbox	18.75:3: 10:1



PERFORMANCE

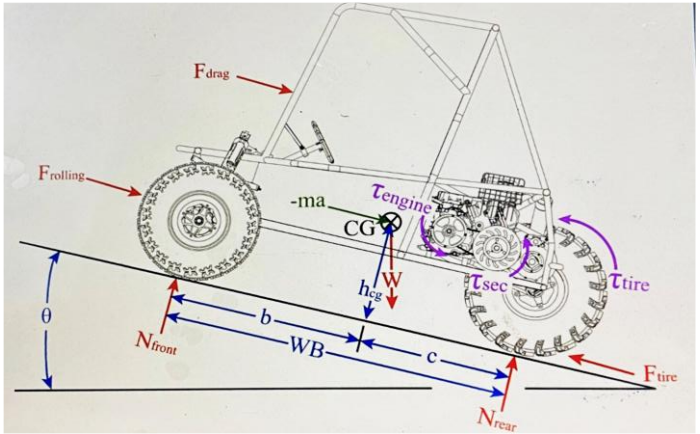
PARAMETER	VALUE
Maximun speed	53 Kmph
Acceleration	6.7 m/s
Gradeability	70 %
Vehicle required torque	780 N-m

POWER TRAIN

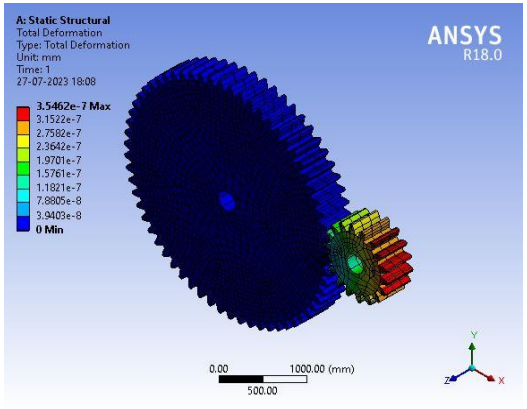
PARAMETER	VALUE
Throttle pedal force	190 N
Pedal travel	65 mm

- **Output ratio of engine to the wheel rpm is 6.97**

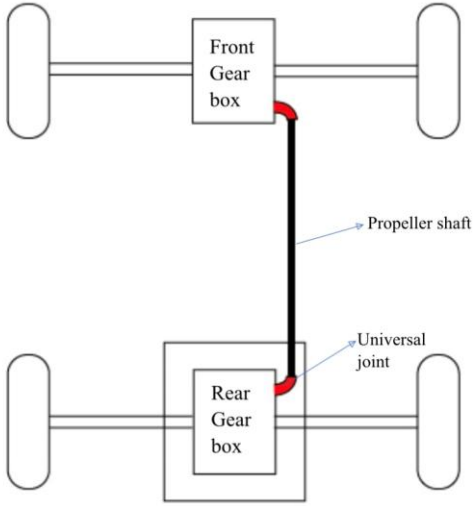
VEHICLE TRAVELS ON A SLOPE CONDITION



CAE ANALYSIS



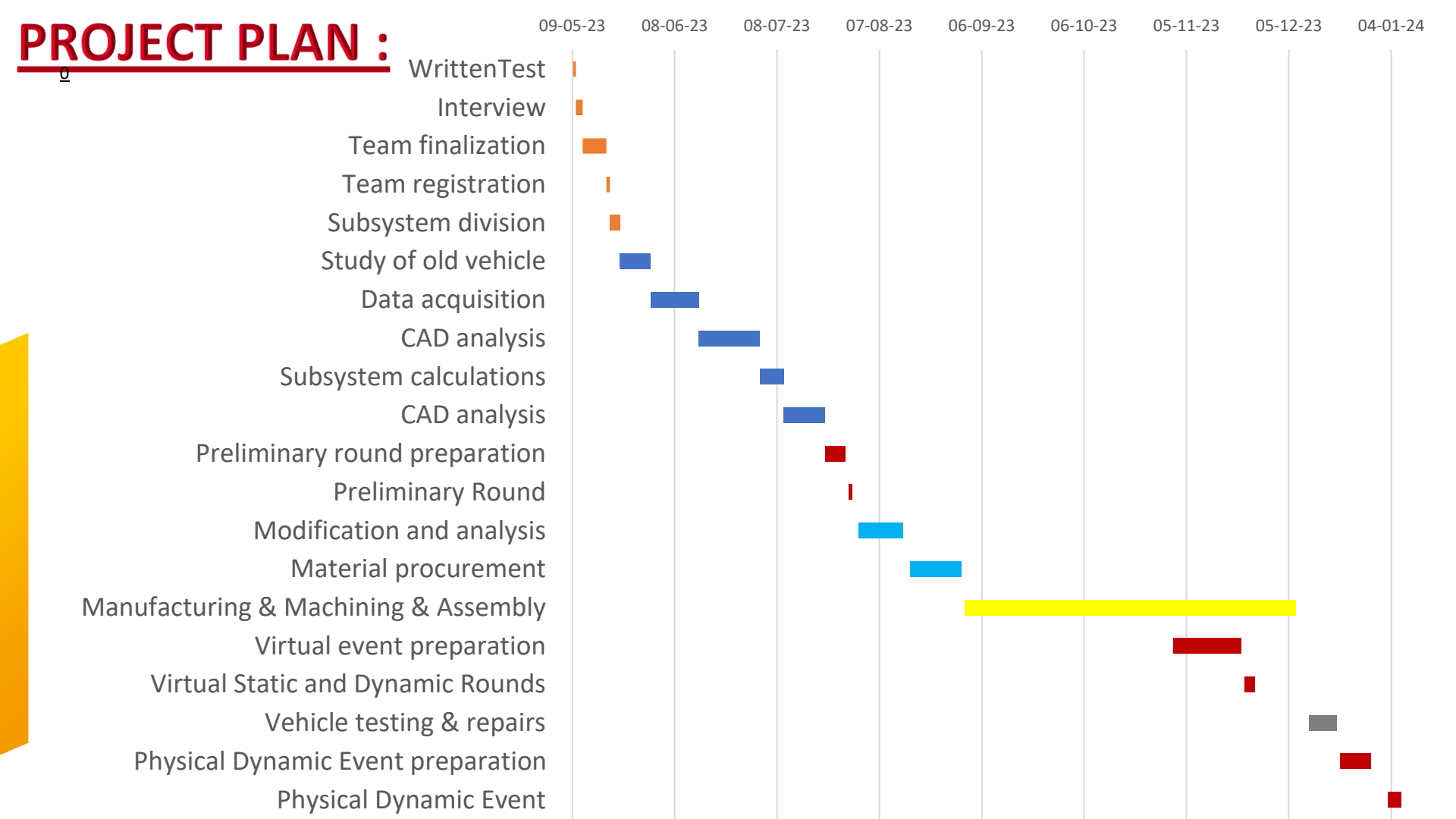
POWER TRAIN LAYOUT



Noise vibrations & Harshness considerations

* Using aluminium Brush
* Using Rubber Damper

PROJECT PLAN :



DESIGN & PROCESS FAILURE MODE EFFECT ANALYSIS

PART	FUNCTION	FAILURE MODELS	S	O	D	RPN	REMEDY	S	O	D	RPN
Rollcage	To ensure safety to the driver	Deformation due to impacts	8	4	3	96	Using Steel Alloys of yield strength more than 365 Mpa	8	2	2	32
Steering	To ensure the directional stability	Steering arm failure	8	3	3	72	Steering arm is designed for maximum load conditions	9	2	2	36
transmission	To provide torque to all its wheels simultaneously	Vehicle becomes inoperatable	8	5	6	240	Connections are to be keenly checked in each and every phase	9	5	3	135
Suspension	Maintaining balance to vehicle and to safe guard from sudden shock and rollover	Spring fractures and failures	7	3	5	105	Choose material and machining sequence according to spring constant	8	2	4	64
Brakes	To inhibits motion by absorbing energy from moving system	Circuit failure due to leakage & Worn out Brake pads	9	4	5	180	Bleeding of Vehicle Brakes before every run and replacement of required parts	9	3	2	54

S - SERVERITY O - OCCURRENCE D - DETECTION RPN – RISK PRIORITY NUMBER

DESIGN VALIDATION PLAN

SYSTEM	PARAMETER	CHECKING METHODOLOGY	DESIGN VALUE
ROLLCAGE	Sustainability crashes	Using ANSYS software	FOS : 2
SUSPENSION	Wheel Travel	Vehicle is lifted by using jack, wheel is removed and hub travel is noted with respect to center position.	Bump : 6 inch Droop : 4 inch
STEERING	Turning Radius	To be tested in the figure of:- 8	Based on physical performance
POWER TRAIN	Top Speed	Vehicle is driven at full throttle up to a distance of 200ft and note the speed and also time taken to cover the distance is noted using sensors	Based on physical performance
BRAKING	Stopping distance	Driver starts braking at minimum speed (45kmph) while crossing a reference line. Maximum force is applied on the brake pedal, there by checking all wheels lock simultaneously or not and distance is measured from the line to the front tires.	Based on physical performance

TEAM COMPOSITION

TEAM TACHYON 6.0

MR.BHIMESH REDDY

DESIGN	TRANSMISSION	BRAKING	SUSPENSION	STEERING
KARUNAKAR	SUBHASH	SHYAM	NARAYANA	SREE KIRAN
S SWAROOP	MANIKANTA	RAMESH ©	GANESH	VISWA
MOHAN	KALYAN	KASI	SUBHANI	SHANKAR
DILEEP	VIJAY	CHANDHU	RAJU	VAMSI (D)
MADHAV	HARISH	NITHIN	CHANDHU	ARAVIND
JAHNAVI	MOULYA SRI	SIREESHA	GAYATHRI	N SIREESHA


CNC


PIPE BENDING

Old members **New members** **Faculty advisor**

COLLEGE WORKSHOP FACILITIES